UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
POST-CONSTRUCTION INITIAL PERFORMANCE
EVALUATION REPORT (IPER4F)

BAY ISLAND HABITAT REHABILITATION AND ENHANCEMENT PROJECT

DECEMBER 1999

US Army Corps
of Engineers
Rock Island District

· POOL 22
MISSISSIPPI RIVER MILES 311-312
MARION COUNTY, MISSOURI

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING – P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO
ATTENTION OF:

CEMVR-PM-M

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM (UMRS-EMP) POST-CONSTRUCTION INITIAL PERFORMANCE EVALUATION REPORT (IPER4F)

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ACRONYMS

DPR	Definite Project Report
EMP	Environmental Management Program
HREP	Habitat Rehabilitation and Enhancement Project
IPER	Initial Performance Evaluation Report
MDOC	Missouri Department of Conservation
NWMU	North Wetland Management Unit
O&M	Operation and Maintenance
SWMU	South Wetland Management Unit
UMRS	Upper Mississippi River System
USFWS	United States Fish and Wildlife Service
WMU	Wetland Management Unit

ACKNOWLEDGMENT

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1. INTRODUCTION

The Bay Island, Missouri, Habitat Rehabilitation and Enhancement project, hereafter referred to as "the Bay Island project," was completed as part of the ongoing Upper Mississippi River System (UMRS) Environmental Management Program (EMP). The Bay Island project is located approximately 1 mile north of Hannibal, Missouri (see plate 1).

a. Purpose. The purposes of this Initial Performance Evaluation Report (IPER) are as follows:

(1) Summarize the performance of the Bay Island project, based on the project goals and objectives.

(2) Review the monitoring plan for possible revision.

(3) Summarize project operation and maintenance efforts to date.

(4) Review engineering performance criteria to aid in the design of future projects.

b. Scope. This report summarizes available project monitoring data, inspection records, and observations made by the U.S. Army Corps of Engineers (Corps) and the Missouri Department of Conservation (MDOC) for the period from March 1987 through January 1999.

2. PROJECT GOALS, OBJECTIVES, AND MANAGEMENT PLAN

a. General. The Bay Island project was constructed to provide high quality, dependable wetland habitat for migratory waterfowl. Water level management capabilities were achieved through the construction of a levee system, pump station, and water control structures. Construction of the levee system resulted in the creation of two independent management units. A pump station and multiple stoplog structures were built into the levee system to facilitate control of water levels. Mast producing trees were planted to provide additional food resources (see plate 2).

b. Goals and Objectives. Project goals and objectives were formulated during the project design phase and are summarized in Table 2-1.

TABLE 2-1

Project Goals and Objectives

Goals	Objectives	Project Features
Enhance Wetland Habitat for Migratory Waterfowl	Provide controlled water levels during waterfowl migration—forested and non-forested. Increase reliable food production area (moist-soil species).	Earthen levee, pump station, stoplog structures
	Increase mast tree dominance—forested wetland	Mast tree plantings including seedlings and acorns
	Increase total wetland values for migratory waterfowl	All project features are intended to enhance wetland values

c. Management Plan. No formal management plan was developed for this project.[1] The project is generally operated as outlined in the project's Operation and Maintenance Manual dated November 1995.

[1] More recent UMRS-EMP HREPs have included the development of formal management plans.

3. PROJECT DESCRIPTION

a. Project Features. Project features include: two wetland management units surrounded by a 2-year event perimeter levee; water supply pump station; stoplog control structures; mast tree plantings; and an access road with bridge. The general view of these project features is illustrated on plate 2.

(1) Wetland Management Units (WMUs). The Bay Island project consists of two WMUs, encompassing approximately 400 acres, delineated by a low-level perimeter levee and cross dike. Water levels are controlled independently in the two units through the use of a pump station and water control structures.

(a) Perimeter Levee. The 19,194-foot-long perimeter levee provides at least a 2-year level of flood protection. The levee has a 10- to 12-foot crown with 4H:1V side slopes. An intermediate levee subdivides the area enclosed by the perimeter levee, creating two WMUs, a north and a south unit, NWMU and SWMU, respectively (see photos 3 and 4, page 14).

(b) Pump Station. The pump station consists of a 6,000-gpm submersible propeller-type pump. This pump has the capacity to fill in the NWMU in 15 days and both units in 23 days. The pump station, located on the south end of the project, pumps water from Ziegler Chute. The pump is housed in a vandal-resistant cast-in-place building. The intake entrance is equipped with a trash rack. Underground single-phase electrical power is provided to the site. All necessary electrical equipment is located on an overhead platform (see photos 1 and 2, page 13).

(c) Water Control Structures. The WMUs have three water control structures. Two water control structures, each having four 5-foot-wide stoplog bays, are located on the perimeter levee. The intermediate levee has one water control structure with two 3-foot-wide stoplog bays. Wood stoplogs are inserted into the control structure bays to establish water ponding elevations. The perimeter levee water control structures are sized to preclude the need for an armored levee overflow section. All of the water control structures have a steel grate deck to allow for vehicle passage overhead (see photos 6, 7 and 8, pages 15 and 16).

(2) Mast Tree Plantings. Approximately 30 acres within the two WMUs were planted with mast trees. Acorns, seedlings, and larger stock were used (see photos 9, 10, and 11, pages 17 and 18).

(3) Project Access Road. Access to the project is gained by a crushed stone access road. The majority of the eastern segment of the access road followed an existing access road alignment. The road is 10 feet wide and surfaced with 6 inches of crushed stone. The road is used by MDOC personnel for operation and maintenance activities and share croppers to access leased crop areas within the site.

A new prefabricated deck bridge with concrete abutments provides project access over Clear Creek. The span length is 42 feet and the deck width is 15 feet. The bridge carries a

standard H20 loading designation. The bottom elevation of the bottom chord of the bridge is 464.4 MSL and was designed to allow passage of a 100-year flow of Clear Creek plus the drainage outflow from the South River Drainage District (see plate 2) with 1 foot of clearance (see photo 5, page 15).

b. Construction and Operation. The project construction contract was awarded on June 18, 1991, to Northwest Construction Corp. under Contract No. DACW25-91-C-0057. Project construction was considered substantially completed on November 18, 1992. Significant damages to the levee and pump station resulted from the record flooding that occurred during the summer of 1993. The original project construction contract was modified to allow repair of project damages resulting from the 1993 flood. These repairs were completed by November 21, 1994. A second construction contract (DACW25-94-C-0073) to replace tree plantings lost during the 1993 flood was completed November 1994.

Operation of the project began in the fall of 1994 after completion of 1993 flood repairs. In general, operation consists of dewatering the WMUs during the March-September timeframe in order to expose mudflats and allow revegetation of moist-soil species. Water is filled into the NWMU and SWMU to elevations 465.0 feet and 466.0 feet MSL, respectively, during the October through February timeframe. Water elevations are controlled to correspond with the growth of the moist-soil plant community and to provide migratory waterfowl access to food plants.

Project operation and maintenance generally consists of: (1) mowing and maintaining the perimeter levee; (2) operating the pump station and water control structures to achieve desired water elevations and minimize overtopping erosion; (3) maintaining (e.g., removal of silt, debris, and undesirable vegetation) the interior drainage and outlet and inlet channels; and (4) controlling vegetation between planted trees. For a more in-depth guide on operation and maintenance, please reference the Project Operation and Maintenance Manual (November 1995).

4. PROJECT PERFORMANCE MONITORING AND PERFORMANCE EVALUATION

a. General. Appendix A presents the Post-Construction Evaluation Plan. This plan was developed during the project design phase and serves as a guide to measure and document project performance. Appendix B contains the Monitoring and Performance Evaluation Matrix and Resource Monitoring and Data Collection Summary. These tables present the types and frequency of data that have been collected to meet the requirements of the Performance Evaluation Plan.

b. Corps of Engineers. The Corps has overall responsibility to measure and document project performance.

c. U.S. Fish and Wildlife Service. The USFWS does not currently conduct any monitoring specific to this site.

d. Missouri Department of Conservation. As refuge manager, the MDOC is required to conduct annual inspections and participate in periodic joint inspections of the project with the Corps. The MDOC also makes regular field observations that aid in determining the success or failure of the project.

5. EVALUATION OF PROJECT OBJECTIVES

Migratory waterfowl habitat is evaluated according to the project goals and objectives as stated in Table 5-1. Based on data and observations collected since project completion, it appears that the stated goals and objectives are being met. However, certain issues still need to be addressed to maximize project outputs and minimize operation and maintenance requirements. These are discussed in the paragraphs that follow.

TABLE 5-1

Project Goals and Objectives

Goals	Objectives	Project Features	Status
Enhance Migratory Waterfowl Habitat	Provide controlled water levels during waterfowl migration—forested and non-forested. Increase reliable food production area (moist-soil species).	Earthen levee, pump station, stoplog structures	Minimally met
	Increase mast tree dominance—forested wetland	Mast tree plantings including seedlings and acorns	Met
	Increase total wetland values for migratory waterfowl	All project features are intended to enhance wetland values	Met

a. Provide Controlled Water Levels During Waterfowl Migration and Increase Reliable Food Production Area. Since construction of the project was completed in 1994, the perimeter levee has been overtopped during spring or early summer virtually every year (1995, 1996, 1997, and 1998) for approximately 2 to 4 consecutive weeks. Once water levels recede in the interior of the WMUs, germination of waterfowl food plants such as smartweeds, beggarsticks, and wild millet occurs on exposed soils. Corps and USFWS staff observed growths of this "moist soil" vegetation in the project area during site visits in the summers of 1996 and 1997.

The MDOC is attempting to manage the area as a greentree reservoir, manipulating water levels to minimize tree mortality. This is accomplished by drawing down the WMUs after fall migration. Beginning in early March, the SWMU will be re-flooded to provide waterfowl feeding areas during spring migration.

Problems with pump operation and the damaging effects of spring flooding continue to limit the ability of site managers to operate and maintain the area to meet project objectives. Site Manager's Inspection Reports from 1998 and 1999 document severe erosion along the western levee and adjacent to the water control structure. The reports state that no permanent vegetative cover has been established on the perimeter or intermediate levees. The inspection reports also noted the inability to independently

manage the NWMU and SWMU. These problems are addressed in Sections 6 and 7 of this document.

b. Increase Mast Tree Dominance - Forested Wetland. In addition to providing a future food source for wildlife, pin oaks were deliberately planted in a unique design to test alternative methods for the establishment of mast trees on Mississippi River bottomland sites. Four planting techniques were tested: (1) planting container-grown tree stock; (2) planting bare-root tree seedlings with tree shelter protection; (3) planting bare-root seedlings without shelters; and (4) planting acorns.

Long-term monitoring of the pin oak plantings in the project area will be conducted to determine the feasibility of each method for potential use in establishing oak trees at future HREP sites. Immediately after tree planting was completed, 1/100 hectare permanent monitoring plots were established within each reforestation area. For each of the three planting techniques involving acorns or bare-root seedlings, nine permanent plots were placed on a systematic grid within each planting area. Study plots alternated between plots with all trees tubed and plots with no tube protection. Six permanent plots were established in the container-grown tree planting area to assess growth. Plot centers were marked with plastic stakes. The permanent sampling plots were recovered and remeasured in October 1995. The preliminary results of this monitoring, first compiled in October 1995, have already been used in the design of more recently constructed HREPs (e.g., Cottonwood Island, Missouri).

First Year Results - In April 1995, the planted bare-root seedlings and container-grown trees initiated a spring growth flush. No acorn sprouts were evident at that time. Shortly thereafter, the Mississippi River rose to flood stage and inundated the planting site for approximately 2 weeks. Acorns and bare-root seedlings were completely overtopped, while the taller container-grown stock managed to maintain at least some new growth above the flood waters. None of the new growth on the bare-root seedlings survived this inundation. Strong currents also removed several of the tree tubes and dislodged many others. Flood waters also deposited a new layer of fine sediment over the planting area. By July 1995, this sediment had dried and consolidated, and many of the seedlings that had their first growth flush killed by inundation produced new growth from lateral buds. Very few acorn sprouts were evident by early July. By October 1995, however, the number of seedlings sprouted from acorns had increased.

By October 1995, overall survival of the 450 container grown trees planted on the 4-acre plot was 99.3 percent. Acorn survival from sample plots was 45.7 percent, yielding 944 seedlings per hectare. Survival of bare-root seedlings, both tubed and not tubed, was 84.2 percent with 978 trees per hectare after one year. Sixty-three percent of the sample trees that were placed in tubes in November 1994 had their tubes washed away in the 1995 spring flood. The bare-root subgroup that did not have tubes installed exhibited 88.9 percent survival. Survival for the subgroup that had tubes installed (and remained in tubes for the entire period), was similar at 94.6 percent. However, sample trees that were initially tubed for the first 6 months and then had the tubes washed away by flood waters,

had only a 70.3 percent survival rate. This subgroup apparently experienced additional stress from the flood event.

The MDOC plans to establish approximately 2 acres of container-grown mast tree seedlings in the SWMU adjacent to the perimeter levee just upstream of the pump station. These trees were to be planted in raised windrows approximately 30 feet apart, with a cover crop of red top. Red top is a cool season grass that grows to a maximum height of about 18 inches and is expected to help reduce competition from weeds and seedling cottonwood. MDOC staff prepared the ground for the planting in the late summer of 1997, but agency funding constraints have delayed the establishment of plantings in the prepared plot.

c. Increase Total Wetland Values for Waterfowl. Site Manager's inspection of the project in July 1996 reported observations of a wood duck brood in the NWMU, as well as sightings of great blue heron, killdeer, mourning doves, indigo buntings, woodpeckers (red-headed, red-bellied, and downy), and numerous prothonotary warblers. Wood duck use of the project area was also noted by Corps and MDOC staff during a September 1997 site inspection.

Field notes from the Site Manager's Inspection Report, dated February 6, 1998, reported fair waterfowl use during fall 1997, including an estimated 300-500 mallards on the area for 2 weeks in early December. It was also observed that heavy hunting pressure appeared to limit duck use of the area. This report recorded limited use by shorebirds (e.g., snipe and sandpipers) and wading birds (e.g., herons), as well as river otter and deer. Besides waterfowl hunting, heavy archery deer hunting and some squirrel hunting were reported.

The Inspection Report dated January 20, 1999, reported lower waterfowl use of the area in the fall of 1998 compared to the previous year, but noted that waterfowl hunter numbers remained high. Routine observance of great blue herons and some limited shorebird use were also noted, as was continued use by deer and turkey hunters and trapping of furbearers such as raccoon, opossum, and otter.

6. EVALUATION OF PROJECT OPERATION AND MAINTENANCE

a. Operation Evaluation. An operational critique of the project and its various features follows. This section focuses on challenges and difficulties experienced through operation of the project.

(1) Water Control Structures. The water control structures at Bay Island were designed and constructed with the intention of one person removing and replacing the stoplogs. Stoplogs are constructed out of pressure treated Spruce-Pine with a dimensional size of 5'-$2^{1/2}$"x $5^{1/2}$"x $2^{1/2}$". Additional descriptions of the water control structures are given in Section 3.a.(1)(c).

(a) Challenges or Difficulties. Removal of the wood stoplogs in the water control structures has proven to be more than a one-person operation. It is a struggle for two persons to remove the 5-foot-long stoplogs out of the water control structures.

(b) Actions and Recommendations. Construct overflow spillways on both the NWMU and SWMU. The overflow spillways will allow the WMUs to flood at a set elevation. They will remove the burden of constantly monitoring the Mississippi River for rising elevations and the need to access the site for removal of all stoplogs. Overflow spillways will have crests constructed 1 foot below the existing top of levee and will be approximately 150 feet in length each. Spillways will be armored with riprap to prevent/reduce erosion damage from an overtopping event. With the overflow spillways, WMUs will fill with water automatically in order to minimize head differences prior to the perimeter levee being overtopped.

Plans and drawings will be sent to the MDOC on the latest designs for possibly replacing wood stoplogs with aluminum stoplogs. Aluminum stoplogs will be lighter than the existing wood stoplogs and should be easier to handle and remove. Also, drawings of a sluice gate will be provided to the MDOC. The sluice gate is proposed to be inserted into one of the water control structure bays at each water control structure. Construction and implementation of the aluminum stoplogs and sluice gates will be left up to the MDOC.

(2) Pump Station. For a description of the pump station, see Section 3.a.(1)(6).

(a) Challenges or Difficulties. The pump station has a continuous problem with the pumping chamber and intake area filling in with 2 to 3 feet of silt. The silt layer envelops the pump impellers, thus making the pump station inoperable until the pumping chamber is cleaned out. Removal of silt in the pumping chamber has been labor intensive and difficult to complete. Silt accumulation in the pumping chamber and around the pump impellers creates different power demands on the pump motor. Fluctuation in the pump motor loads or possibly incoming power supply has been throwing the phase converter out of balance. The services of an electrical contractor to recalibrate the phase converter have been needed about twice annually since the pump station has been in service. A 10 percent

change in motor kilowatts or horsepower is enough to move the phase converter to an unbalanced condition, making it non-operational.

(b) Actions and Recommendations. Construct a slide gate on the outside of the pump station intake structure and build a platform structure in the pumping chamber. The slide gate will be placed at the intake of the pump station near the existing trash rack. It will be closed during non-pumping times to prevent the buildup of silt in the pumping chamber. Without the buildup of silt, the phase converter should no longer have a problem of being thrown out of balance. A platform with a ladder will be installed to facilitate cleaning out of any silt that collects inside the pumping chamber. Information on air-lift pumps will be forwarded to the MDOC.

(3) Wetland Management Units (WMU). For a description of the WMUs, see Section 3.a.(1).

(a) Challenges or Difficulties. Due to through seepage, the SWMU drops approximately 0.75 foot per day once filled. An exposed sand layer area along the bottom of the water supply ditch is suspected to be the location where water is being lost. As a result, frequent pumping is required to maintain desired water elevations.

Although the project was designed to allow separate operation of the two WMUs, such operation has not been possible due to the water supply embankment being below design grade and the lack of a closure structure on the interior drainage.

(b) Actions and Recommendations. Recommend the area of the suspected exposed sand layer be sealed off by mixing bentonite clay into the top 6 inches of soil. Technical advice will be forwarded to the MDOC on applying bentonite.

Fill will be added to the water supply embankment to raise it up to 1 foot above its original design grade. This additional foot is necessary to accommodate operation of the south WMU 1 foot higher than its originally intended ponding elevation. A new RCP culvert with a gatewell will replace the existing drainage pipe. The water supply embankment will be raised up to the elevation of the intermediate levee for the stretch of embankment from the culvert over to the intermediate levee. This will allow access by vehicle to the culvert and slide gate when water is impounded in the WMUs. A seed mixture containing Switchgrass, Red Top, and Virginia Wild Rye will be planted on the regraded water supply embankment.

b. Maintenance Evaluation. The following paragraphs identify maintenance items that the MDOC recorded during operation and inspection of the Bay Island project.

(1) Perimeter Levee. For a description of the perimeter levee, see Section 3.a.(1)(a).

(a) Challenges or Difficulties. Severe erosion along the northwestern edge of the perimeter levee has been evident since the 1993 flood. Approximately 1,070 feet of

the perimeter levee toe is eroding due to Clear Creek. The erosion has created about a 2- to 3-foot vertical cut into the levee toe. Clear Creek is a meandering stream that runs along this portion of the levee. The bottomland that Clear Creek runs through is heavily wooded and frequently inundated by discharges from the South River Drainage District pump station.

(b) Actions and Recommendations. Grade remaining levee slope and place a layer of riprap. The riprap will be well graded so that a bedding layer will not be required. The riprap layer will be placed 6 feet off the edge of levee crown and run down to the base of the levee toe for the stretch of levee where erosion is evident.

(2) Tree Seedling and Acorn Plantings.

(a) Challenges or Difficulties. Minimal to no success was achieved from the planting of tree seedlings and acorns at Bay Island. Some of the failure can be attributed to the major flooding of this site since project completion. Planting areas have been unable to compete with other vegetation. Apparently, the plantings were too close together and not adequately marked for MDOC's mowers to navigate around, and seedlings and acorn plantings were difficult to locate once competing vegetation had grown up. Seedlings that had plastic tubes placed around them died as a result of being silted in during high water events.

(b) Actions and Recommendations. Additional trees have been planted since the 1993 flood. More trees will be added to the project as funding allows in the areas where the seedlings and acorns failed to grow. Recommend that future plantings be larger stock trees. Spacing and marking of tree plantings should be more closely coordinated with the local sponsor.

(3) Permanent Vegetative Cover.

(a) Challenges and Difficulties. A permanent vegetative cover has not been established on the perimeter and intermediate levees. Smartweeds and other annual herbaceous plants grow on the exposed levee soils; however, this annual vegetative cover tends to have smaller root systems that provide little or no erosion protection.

(b) Actions and Recommendations. A perennial seed mixture will be planted on the water supply berm after it is brought up to design grade. The seed mixture will contain Switchgrass, Red Top, and Virginia Wild Rye. Virginia Wild Rye will be used in limited areas due to its expense. Recommend monitoring the success of this seed mixture for potential future planting on levee embankments that experience annual inundation.

7. GENERAL CONCLUSIONS AND RECOMMENDATIONS

Discussions with MDOC and Corps personnel who are involved with operation, maintenance, and monitoring activities at the Bay Island project have resulted in general conclusions regarding project features that may affect future project design.

a. Level of Protection. A 2-year level of protection, such as is the case at the Bay Island project, should only be used at sites where impacts of frequent flooding are acceptable for project operation and maintenance. Recommend that perimeter levees provide at least a 5-year level of protection. A higher level of protection will decrease the rate of siltation that slowly fills in the protected managed areas and will increase controlled management opportunities. Establishing new tree plantings at the Bay Island project became a problem due to untimely flooding events. A higher level of levee protection would decrease the risk of prolonged flooding when trying to establish desired vegetation.

b. Water Supply Systems. Recommend extra attention be given to the selection and design of water supply systems in relation to potential siltation problems on future HREPs. Reliability and risk versus cost of a water supply system need to be closely evaluated. The uncertainty of dynamic conditions associated with river channels and flood plains require water supply systems capable of functioning in a physically challenging environment. The capabilities of the project sponsor to operate and maintain the project need to be weighed into the design. If pump stations are built, recommend providing closure gates on the intakes so that the pumping chambers can be closed off during periods of non-use.

c. Water Control Structures. Recommend consideration be given to the added benefit of establishing a higher level of protection and including overflow spillways into the levee system. Overflow spillways take the burden off of the local sponsors to open closure structures in a timely fashion. Any stoplog structures built in conjunction with future projects should be designed and constructed to allow easy removal and installation of the stop logs by one person.

The south unit has experienced some seepage during operation. Sandy material associated with the water supply ditch is suspected to be the source of this problem. To seal these areas, the Corps has proposed incorporating bentonite into the bottom of the supply ditch. In addition, modifications being made to the water supply berm adjacent to this reach of the water supply ditch will further separate the ditch from the south management units, thus potentially reducing the seepage rate within the unit itself.

d. Mast Tree Plantings. Recommend that future HREPs pursue more mast tree plantings that consist of container-grown or balled and burlapped trees. If seedlings or acorns are used, the layout should be coordinated with the local sponsor who will be maintaining the site to ensure that trees are clearly marked and appropriately spaced for the mowing equipment to be used at the site.

e. Site Access. Site access for management purposes is hampered by inundation of the site access bridge. Water starts flowing over the bridge deck at elevation 466.0 feet MSL. There is approximately a 50 percent chance in any given year that this river stage will be reached or exceeded. Additional bridge inundation events also may occur at slightly lower stages when the South River Drainage District is discharging. Options for elevating the site access bridge are being investigated.

SITE PHOTOGRAPHS

Photo 1. Pump station and electrical control equipment platform.

Photo 2. Pump station outfall.

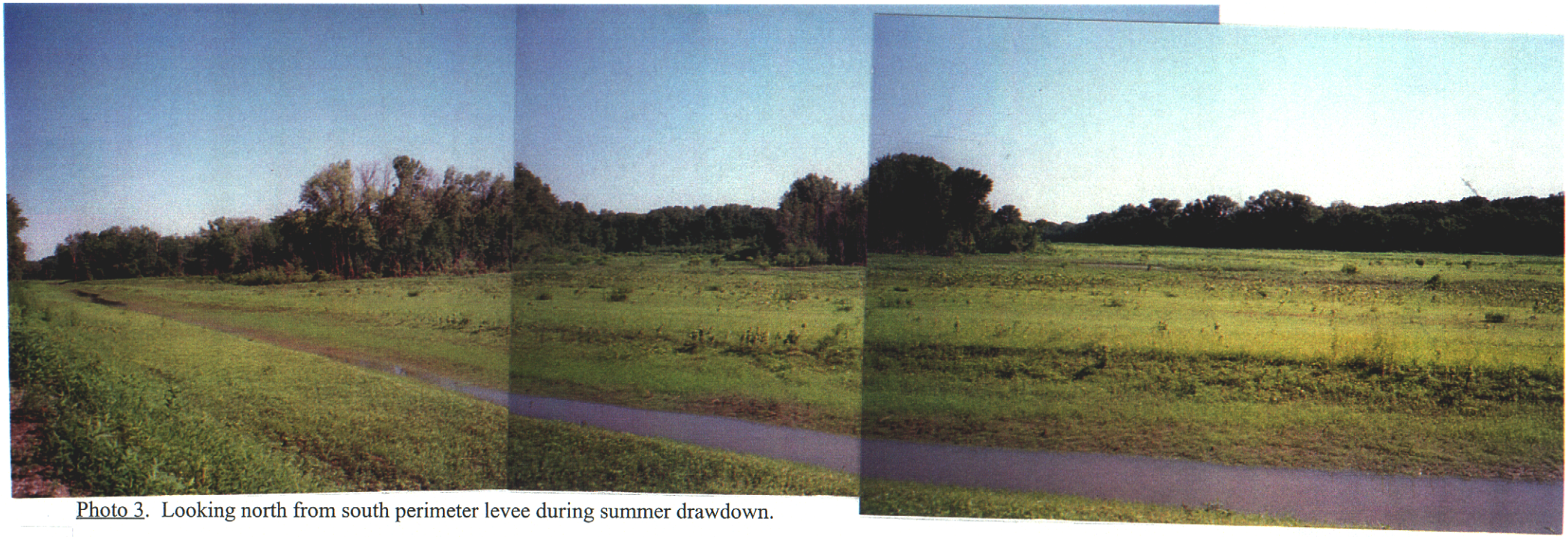

Photo 3. Looking north from south perimeter levee during summer drawdown.

Photo 4. Perimeter levee and south water control structure.

Photo 5. Site access bridge.

Photo 6. Perimeter water control structure with stop logs in place.

Photo 7. Perimeter water control structure with stop logs removed.

Photo 8. Intermediate (interior) water control structure (2-bay stop logs)

Photo 9. Bare-root tree seedlings with tree shelter protection.

Photo 10. Seedling sprouted from acorn.

Photo 11. Container-grown tree stock.

APPENDIX A

POST-CONSTRUCTION EVALUATION PLAN

TABLE A-1

Bay Island Rehabilitation and Enhancement Project
Post-Construction Evaluation Plan
Enhancement Potential

Goal	Objective	Enhancement Feature	Unit	Year 0 (1994) Without Alternative	Year 1 (1994) With Alternative (As-Built)	Year 50 Target With Alternative	Feature Measurement	Annual Field Observations by Site Manager
Enhance Wetland Habitat for Migratory Waterfowl	Provide controlled water levels during waterfowl migration—forested and non-forested	Wetland Management Units	Acres	40 (uncontrolled)	400	400	Areal vegetation surveys	Observe/record development of emergent vegetation
	Increase mast tree dominance—forested wetland	Mast Tree Plantings	Acres	6.9	30	36.9	Timber inventory	Observe/record tree mast
	Increase total wetland values for migratory waterfowl	All	Habitat Suitability Indices & Habitat Units	0.14 99.1		0.62-0.64 420.5-434.0	WHAG analysis	

APPENDIX B

MONITORING AND PERFORMANCE EVALUATION MATRIX
AND
RESOURCE MONITORING AND DATA COLLECTION SUMMARY

TABLE B-1

Bay Island Habitat Rehabilitation and Enhancement Project
Monitoring and Performance Evaluation Matrix

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Implementation Instructions/Notes
Pre-Project	Pre-Project Monitoring	Establish need of proposed project features.	MDOC	MDOC	MDOC	--
Design	Baseline Monitoring and Data Collection for Design	Establish baseline conditions; meet specific design data requirements.	Corps	Corps	Corps (HREP)	--
Construction	Construction Monitoring	Assess construction impacts; meet permit requirements.	Corps	Corps	Corps (HREP)	--
Post-Construction	Performance Evaluation Monitoring	Continue monitoring and assess physical, chemical, and vegetation performance of project relative to design goals and objectives.	Corps (quantitative) Sponsor (field observations)	Corps MDOC	Corps (HREP) MDOC	--
	Analysis of Biological Responses to Projects	Evaluate biological response predictions and assumptions.	Corps	Corps	USFWS	Intensive biological response monitoring of this project, as part of the HREP element of the UMRS-EMP, is not scheduled. Annual waterfowl census data will be obtained from the USFWS to evaluate waterfowl response to the project.

TABLE B-2

Resource Monitoring and Data Collection Summary

Enhancement Feature	Unit of Measure	Objective	Field Observations [1/]			Quantitative Measurements		
			Observation	Monitoring Interval	Monitoring Agency	Monitoring Plan	Monitoring Intervals (Years [2/])	Monitoring Agency
Wetland Management Units—forested and non-forested	Acres	Provide controlled water levels during waterfowl migration—forested and non-forested	Presence of waterfowl	Annually	USFWS and MDOC	Perform Areal Surveys	5	Corps
Mast Tree Plantings	Acres	Increase mast tree dominance—forested wetland	Survival of plantings	Annually	MDOC	Timber Inventory	10	Corps
Entire Project	Habitat Suitability Indices & Habitat Units	Increase total wetland values for migratory waterfowl	Presence of waterfowl	Annually	USFWS and MDOC	WHAG Analysis	1, 15, 50	Corps

[1/] To be submitted to the Corps of Engineers by the USFWS with the annual management report for Cooperative Agreement Lands.
[2/] Monitoring intervals are based on 1999 as being year zero, with subsequent 5-year intervals.

APPENDIX C

COOPERATING AGENCY CORRESPONDENCE

Bay Island Rehabilitation and Enhancement
River Miles 311-312
Site Manager's Project Inspection and Monitoring Results
Marion county, Missouri

Partially Inspected by Ross Adams on July 3, 1996

The flood waters were off the access road and bridge. A small amount of silt covered the access road for a short distance near the bridge which may need gravel or grading. There was considerable flood debris on the road and dikes so they were not drivable. The river was still dropping and the diked units were being dewatered through the water control structures.

I hiked from the pump station to station 80+00 on the west perimeter levee. The pump station appeared to have survived the flood in good condition. Except for the flood debris the perimeter levee was in good condition except for minor erosion on the inside slope of the levee north of the water control structure at station 80+10.

Smart weed and millet plants sprouted on exposed soils. If the river continues to drop, additional germination should occur and the plants should have time to set seed before the first frost.

I observed a brood of wood ducks in the trees in the north management unit. Numerous prothonotary warblers were singing on the area. Other species observed in small numbers included red-headed, red-bellied and downy woodpeckers (no surprise there with all the dead trees following the flood of '93), great blue herons, killdeer, mourning doves, indigo buntings, and the usual crows, vultures, red-wing blackbirds and grackles.

Gary Swenson inspected the tree plantings during the week of June 17 and said he would advise Celia Kool of the results.

Several gar were feeding on smaller fish in the flowing water at the water control structures.

I did not inspect the north and east perimeter levees and the intermediate levee and, therefore, I can not comment on their condition.

Ross Adams

BAY ISLAND REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILES 311 THROUGH 312
MARION COUNTY, MISSOURI

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected By Keith Jackson Date 2-6-98

Type of Inspection: (X) annual ( ) emergency-disaster ( ) other

1. PROJECT INSPECTION.

	Item	Condition
a. Perimeter Levee		
(x)	Settlement, sloughs or loss of section	No
(x)	Wavewash, scouring	*Severe erosion on new corner at base of levee
(x)	Overtopping erosion	Major repair with heavy equipment & road rock
(X)	Vegetative cover (mowing)	Grass cover, never established, little herb cover
(X)	Burrowing animals	No
(X)	Unauthorized grazing or traffic	No
(x)	Encroachments	No
(X)	Unfavorable tree/shrub growth	No
		*Erosion caused by South River Drainage District discharges. Rip rap needed (500 feet) at base of levee to prevent undercutting.
b. Intermediate Levee		
(x)	Settlement, sloughs or loss of section	No
(x)	Wavewash, scouring	No
(x)	Overtopping erosion	Very small amount
(x)	Vegetative cover (mowing)	No permanent cover established
(x)	Burrowing animals	No
(x)	Unauthorized grazing or traffic	No
(x)	Encroachments	No
(x)	Unfavorable tree/shrub growth	No
c. Water Control Structure - North Perimeter Levee		
(x)	Stoplogs, stoplog keepers, stoplog slots	Good
(x)	Concrete	Good
(x)	Steel rails, rail posts, grating, fasteners	Good
(x)	Displaced/missing riprap	Good
(x)	Inlet and outlet channels	Good
(x)	Erosion adjacent to structure	Required repair with heavy equipment this year.
(x)	Sedimentation (culverts/approaches)	OK

Item		Condition
d. Water Control Structure - South Perimeter Levee		
(x)	Stoplogs, stoplog keepers, stoplog slots	Good
(x)	Concrete	Good
(x)	Steel rails, rail posts, grating, fasteners	Good
(x)	Displaced/missing riprap	Good
(x)	Inlet and outlet channels	Good
(x)	Erosion adjacent to structure	Good
(x)	Sedimentation (culverts/approaches)	Good
e. Water Control Structure - Intermediate Levee		
(x)	Stoplogs, stoplog keepers, stoplog slots	Good
(x)	Concrete	Good
(x)	Steel rails, rail posts, grating, fasteners	Good
(x)	Displaced/missing riprap	Good
(x)	Inlet and outlet channels	*Inlet channel does not function properly
(x)	Erosion adjacent to structure	None
(x)	Sedimentation (culverts/approaches)	Very little
		*Can't fill north unit without first filling South.
f. Flood/Drainage Ditch		
(x)	Debris	Some-removed summer prior to pumping
(x)	Unauthorized structures	None
(x)	Bank erosion	Little
g. Pump Station		
(x)	Structure - steel	Ok
(x)	Structure - concrete	Ok
(x)	Structure - wood	Ok-wobbly-poor design
(x)	Displaced/missing riprap	Some erosion at outlet pipe
(x)	Electrical controls	Questionable -see comments
(x)	Steel discharge pipe/flapgate	Ok
(x)	Forebay/sump (sedimentation)	(major problem)Sump below slough bottom by 2-3 feet
h. Vegetation		
(x)	Mast Trees	Good survival on RPM planting
(x)	Seeding	Poor survival
I. Access		
(x)	Bridge	Ok
(x)	Road - granular surfacing, etc.	Replacement necessary because of overtopping erosion.
(x)	Piers - riprap	Ok

2. COMMENTS.

ggest headaches are sedimentation in pump & spring flooding (damages levees - and have to pull :op logs in anticipation of rising river - which eliminates management opportunities for spring :tland habitat).

:calibration of phase converter this summer appears to have taken care of much of the problem th the pump shutting off.

diment deposition in pump sump still a problem- it is lower in elevation than adjacent river ute.

af and debris buildup on intake grate during pumping operations blamed for pump shutting off is fall - due to excessive water flow restrictions which causes float to shut pump down.

ring flooding causes extensive damage to levees and considerable sedimentation (sand) on upper enc

C planted Japanese millet in open portion of South unit, but dry weather caused it to fail.

n Dalrymple and his crew constructed and seeded berms for mast tree plantings in fouth mgt unit jacent to natural river levee. Current MDC cash-flow problems means planting of RPM ees in 1998 or 1999 highly unlikely.

ir waterfowl use, espeically early during season, but (26 parties opening day) high hunter numbers shed ducks off. Group of 300-500 mallards on area early December for 2 weeks. Limited shorebird e (Snipe, sandpipers) and wading birds (herons), two otters trapped in Clear Creek, and several er on area. Heavy archery deer hunting use, some squirrel hunting, and considerable waterfowl ıting.

ıoded North unit to elevation 465 (104 flooded acres) and South unit to elevation 466 (88.8 floode es). North unit dropped only 0.25 feet in elevation from 10/21-12/4. Started drawing water off 0-98. South unit dropped 0.73 feet from 10/24-10/31 (7 days). Pumped twice during waterfowl son to maintain target water levels and unit was dry (563.3) at 2-2-98.

ns are to reflood South unit beginning early March and allow water to seep away for spring erfowl migration.

Site Manager

BAY ISLAND REHABILITATION AND ENHANCEMENT
OPERATION AND MAINTENANCE MANUAL

UPPER MISSISSIPPI RIVER ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 22, RIVER MILES 311 THROUGH 312
MARION COUNTY, MISSOURI

SITE MANAGER'S PROJECT INSPECTION AND MONITORING RESULTS

Inspected By Keith Jackson Date 1-20-99

Type of Inspection: (X) annual ( ) emergency-disaster ( ) other

1. PROJECT INSPECTION.

	Item	Condition
a. Perimeter Levee		
(X)	Settlement, sloughs or loss of section	No
(X)	Wavewash, scouring	*Severe erosion along western levee
(X)	Overtopping erosion	No
(X)	Vegetative cover (mowing)	Grass cover never est., little herb. cover
(X)	Burrowing animals	No
(X)	Unauthorized grazing or traffic	No
(X)	Encroachments	Some-blown down trees & ditch debris hamper
(X)	Unfavorable tree/shrub growth	No mowing.
b. Intermediate Levee		*Erosion increased by South River Drainage Dist. discharge. Rip rap needed (approx. 11,000 feet)
(X)	Settlement, sloughs or loss of section	No
(X)	Wavewash, scouring	Slight
(X)	Overtopping erosion	Slight
(X)	Vegetative cover (mowing)	No permanent grass cover est.
(X)	Burrowing animals	No
(X)	Unauthorized grazing or traffic	No
(X)	Encroachments	No
(X)	Unfavorable tree/shrub growth	No
c. Water Control Structure - North Perimeter Levee		
(X)	Stoplogs, stoplog keepers, stoplog slots	Good
(X)	Concrete	Good
(X)	Steel rails, rail posts, grating, fasteners	Good
(X)	Displaced/missing riprap	No
(X)	Inlet and outlet channels	Good
(X)	Erosion adjacent to structure	No
(X)	Sedimentation (culverts/approaches)	Very little

Item		Condition

d. Water Control Structure - South Perimeter Levee

(X)	Stoplogs, stoplog keepers, stoplog slots	Good
(X)	Concrete	Good
(X)	Steel rails, rail posts, grating, fasteners	Good
(X)	Displaced/missing riprap	No
(X)	Inlet and outlet channels	*Inlet does not function properly
(X)	Erosion adjacent to structure	No
(X)	Sedimentation (culverts/approaches)	Very little

*Can't fill north unit w/o first filling south.

e. Water Control Structure - Intermediate Levee

(X)	Stoplogs, stoplog keepers, stoplog slots	Good
(X)	Concrete	Good
(X)	Steel rails, rail posts, grating, fasteners	Good
(X)	Displaced/missing riprap	No
(X)	Inlet and outlet channels	Good
(X)	Erosion adjacent to structure	None
(X)	Sedimentation (culverts/approaches)	Some - not significant

f. Flood/Drainage Ditch

(X)	Debris	Some - removed prior to pumping
(X)	Unauthorized structures	None
(X)	Bank erosion	Slight

g. Pump Station

(X)	Structure - steel	OK
(X)	Structure - concrete	OK
(X)	Structure - wood	OK - wobbly
(X)	Displaced/missing riprap	None
(X)	Electrical controls	Replaced one relay, phase converter recalibrated
(X)	Steel discharge pipe/flapgate	Good
(X)	Forebay/sump (sedimentation)	Considerable time expended to clean out enough to allow pumping.

h. Vegetation

(X)	Mast Trees	*RPM planting looks very good, small
(X)	Seeding	Acorn planting failed.

*seedling planting heavily invaded with maple and cottonwood, planted seedlings not doing well.

I. Access

(X)	Bridge	OK
(X)	Road - granular surfacing, etc.	OK
(X)	Piers - riprap	OK

2. COMMENTS.

Biggest problems continue to be sedimentation in pump sump and spring flooding (damages levee and required removal of stop logs in anticipation of rising river eliminates opportunities for managed spring habitat).

Fewer problems with motor this year, but appears recalibration of the phase converter will be an annual task, and also replaced a relay and all capacitors in the phase converter this year.

Area flooded in spring - early summer (up to mid-June) and again experienced some slight flooding in October.

Mowed parts of the south unit to control cocklebur and seeded Japanese millet. Good natural foods in south unit, only fair in the north unit.

Lower waterfowl use this year compared to last, but hunter numbers remain high. Considerable interest in archery deer/turkey - at least two parties drive from St. Louis to hunt here. Routinely observed Great Blue Herons, limited shorebirds. One trapper harvested five raccoon, one opossum and one river otter. Observed one sick raccoon (probably distemper) during inspection on Jan. 20.

Flooded south unit to elevation 466, and planned to flood north unit to 465 - but flood waters in October pushed north unit to over 465.7 at one time.

North unit holds water very well, south unit drops at an average of 0.7 - 0.8/day when pumped to full pool. Ran the pump a total of 544.4 hours, 510.9 hours spend specifically to pump up water levels or maintain water levels for waterfowl season.

Site Manager

APPENDIX D

REFERENCES

REFERENCES

Published reports which relate to the Bay Island project or which were used as references in the production of this document are presented below.

(1) *Definite Project Report (R-8) with Integrated Environmental Assessment, Bay Island Rehabilitation and Enhancement, Pool 22, River Miles 311-312, Upper Mississippi River, Marion County, Missouri*, March 1990 (DPR). This report presents a detailed evaluation of alternatives to enhance wetland habitat for resident species and migratory waterfowl. Recommended alternatives include low elevation levees, stoplog structures, pump station, mast tree planting, and access improvements. This report marks the conclusion of the planning process and serves as a basis for approval of the preparation of final plans and specifications and subsequent project construction.

(2) *Plans and Specifications, Bay Island, Pool 22, River Mile 311, Upper Mississippi River System, Environmental Management Program, Marion County, Missouri,* Contract No. DACW25-91-C-0057. These documents were prepared to provide sufficient detail to allow construction. Project features include two wetland management units surrounded by a 2-year event perimeter levee, water supply pump station, stoplog control structures, mast tree planting, and an access road with bridge.

(3) *Plans and Specifications, Post Flood Tree Replanting, Bay Island, Pool 22, River Mile 311, Upper Mississippi River System, Environmental Management Program, Marion County, Missouri,* Contract No. DACW25-94-C-0073.

(4) *Operation and Maintenance Manual, Bay Island Rehabilitation and Enhancement, Upper Mississippi River Environmental Management Program, Pool 22, River Miles 311-312, Marion County, Missouri,* November 1995 (O&M Manual). This manual was prepared to serve as a guide for the operation and maintenance of the Bay Island project. Operation and maintenance instructions for major features of the project are presented.

APPENDIX E

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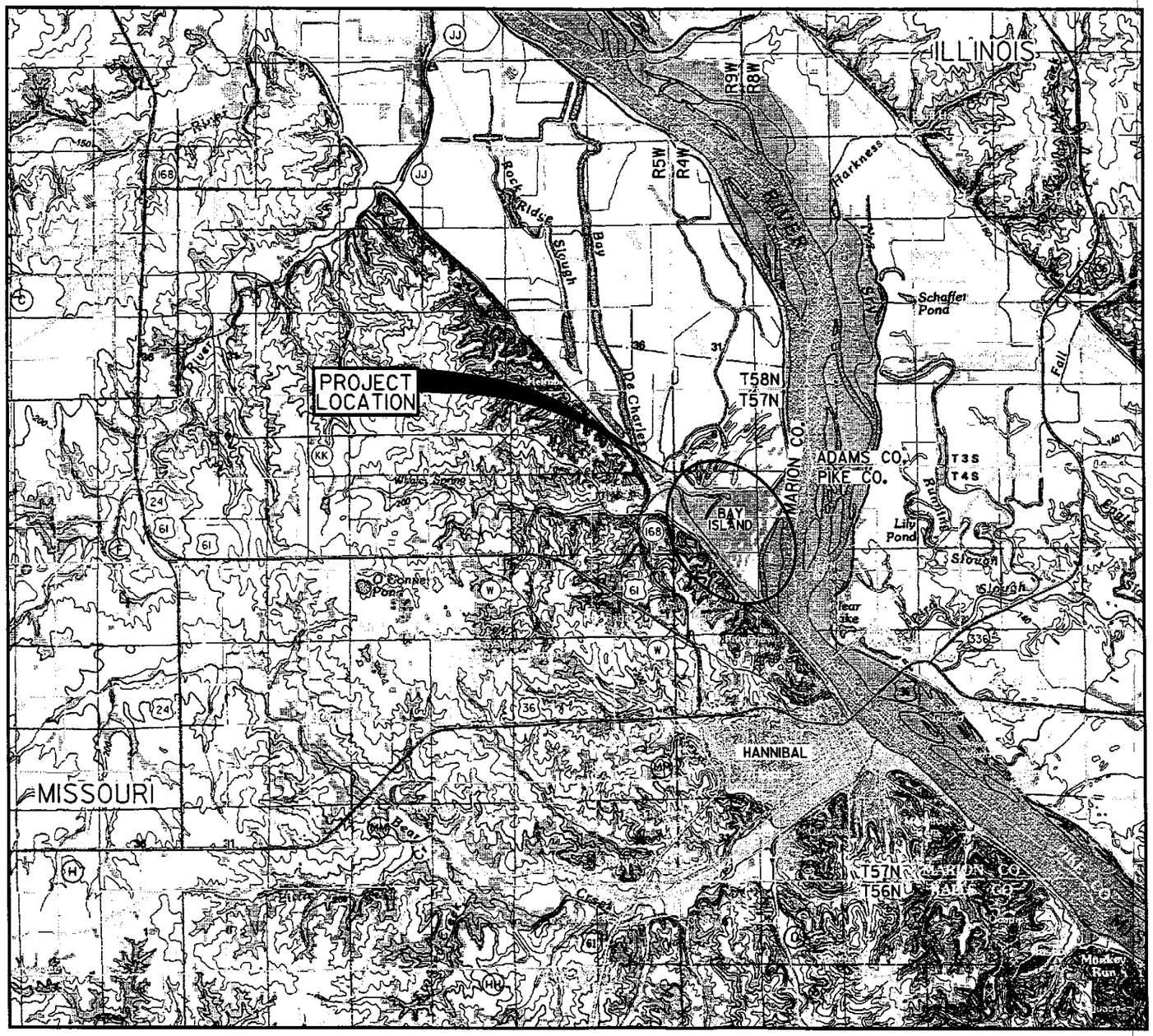
PLATES



LOCATION PLAN

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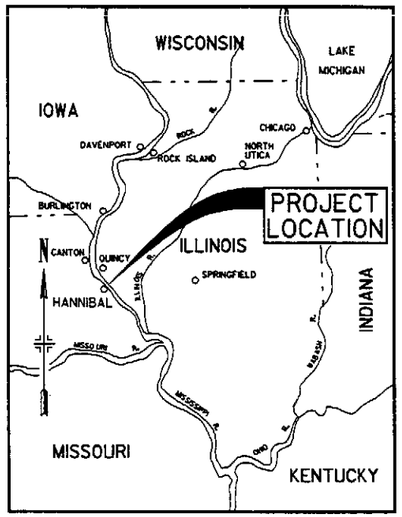
SCALE IN MILES



VICINITY MAP

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SCALE IN MILES

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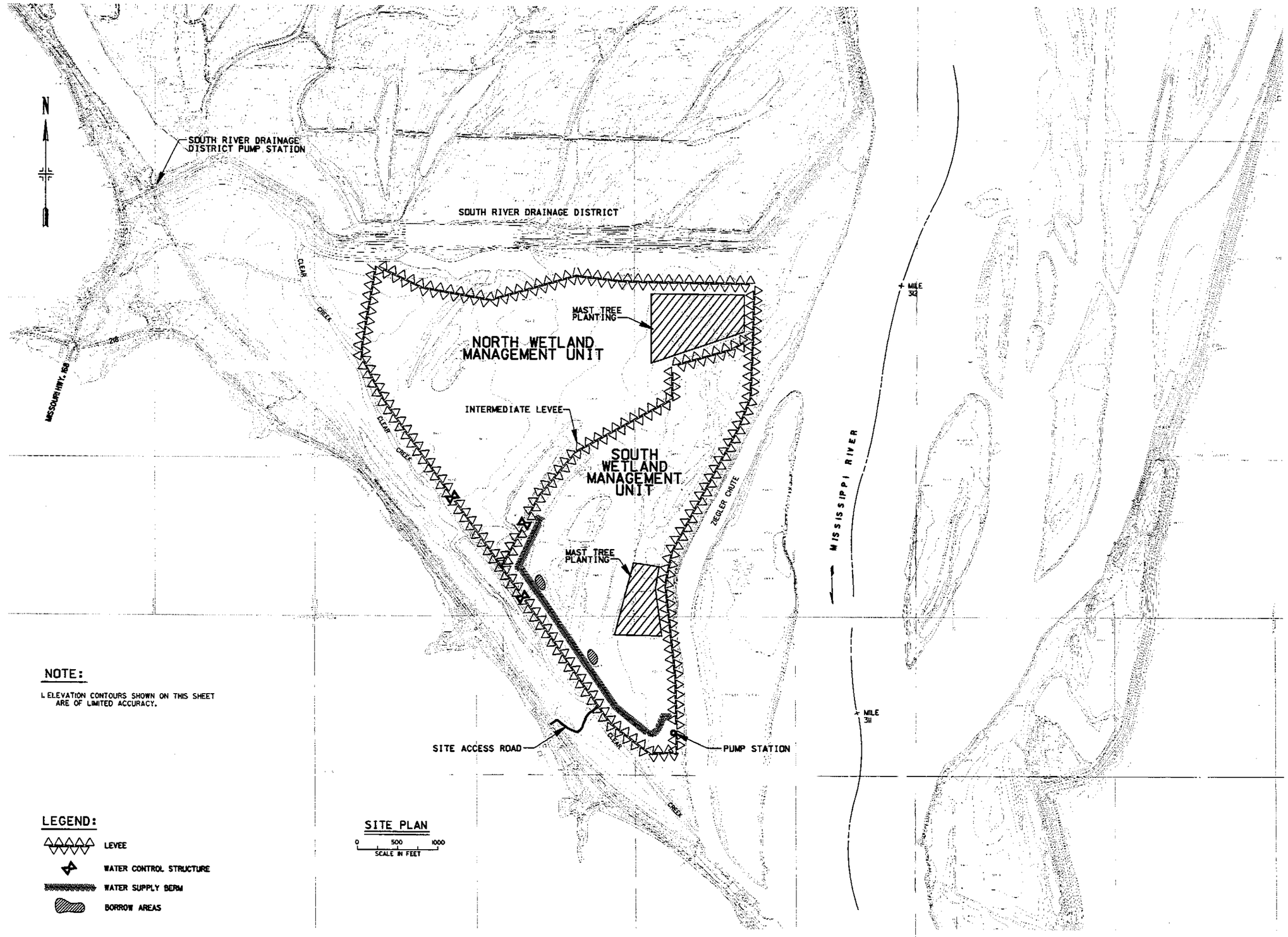
PLATE I



NOTE:

1. ELEVATION CONTOURS SHOWN ON THIS SHEET ARE OF LIMITED ACCURACY.

LEGEND:

- LEVEE
- WATER CONTROL STRUCTURE
- WATER SUPPLY BERM
- BORROW AREAS

SITE PLAN

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SCALE IN FEET

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PLATE 2